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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/799,961	03/12/2004	Randy L. Hoffman	200316547-1	1458
22879	7590	07/29/2011	EXAMINER	
HEWLETT-PACKARD COMPANY Intellectual Property Administration 3404 E. Harmony Road Mail Stop 35 FORT COLLINS, CO 80528				KRAIG, WILLIAM F
2892		ART UNIT		PAPER NUMBER
			NOTIFICATION DATE	
			DELIVERY MODE	
			07/29/2011	
			ELECTRONIC	

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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* RANDY L. HOFFMAN, GREGORY S. HERMAN,  
and PETER P. MARDILOVICH

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Appeal 2009-008056  
Application 10/799,961  
Technology Center 2800

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Before JOSEPH F. RUGGIERO, ELENI MANTIS MERCADER,  
and BRADLEY W. BAUMEISTER, *Administrative Patent Judges*.

MANTIS MERCADER, *Administrative Patent Judge*.

DECISION ON APPEAL

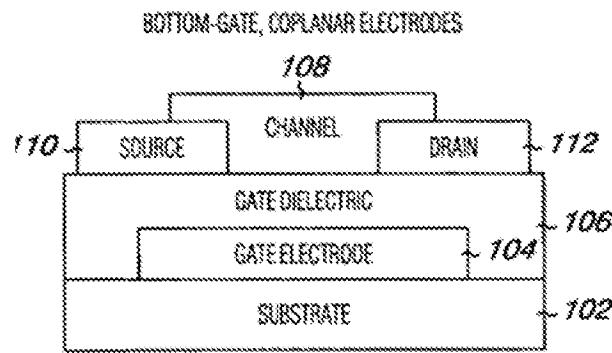
## STATEMENT OF THE CASE

Appellants appeal under 35 U.S.C. § 134(a) from the final rejection of claims 1, 2, 6-18, 20, 37-44, and 48-56. We have jurisdiction under 35 U.S.C. § 6(b).

We reverse and institute two new grounds of rejection within the provisions of 37 C.F.R. § 41.50(b).

## INVENTION

Appellants' Figure 1A is reproduced below:



*Fig. 1A*

Appellants' Figure 1A and claimed invention are directed to a semiconductor transistor having a multicomponent channel 108 including at least one metal cation from group 13 and at least one metal cation from group 14 to form various two, three, four, and five component oxide semiconductor films (Spec. 1; Fig. 1A). The transistor includes source electrode 110, drain electrode 112, channel 108, gate dielectric 106, gate electrode 104, and substrate 102 (Spec. 3; Fig. 1A).

Claim 1, reproduced below, is representative of the subject matter on appeal (emphasis added):

1. A semiconductor device, comprising:

a drain electrode;

a source electrode;

a channel contacting the drain electrode and the source electrode;

wherein the channel includes one or more compounds of the formula  $A_xB_xO_x$ , wherein the one or more compounds of the formula  $A_xB_xO_x$  includes one or more of gallium-germanium oxide, gallium-tin oxide, gallium-lead oxide, indium-germanium oxide, indium-lead oxide, each  $O$  is atomic oxygen, where each  $x$  is a non-zero number, but the value of “ $x$ ” for each constituent element may be different, wherein the channel includes one of an amorphous form and a mixed-phase crystalline form; and

a gate dielectric positioned between a gate electrode and the channel.

## THE REJECTIONS

The Examiner relies upon the following as evidence of unpatentability:

Hamada	JP 05-251705	Sep. 28, 1993
Forrest	US 6,198,091 B1	Mar. 6, 2001
Akimoto	US 6,476,788 B1	Nov. 5, 2002

Raviendra D., *Transparent Conducting PbO<sub>2</sub> Films Prepared by Activated Reactive Evaporation*, 33 PHYSICAL REV. B 2660 (1986).

Julia M. Phillips et al., *Transparent Conducting Thin Films of GaInO<sub>3</sub>*, 65 APPLIED PHYSICS LETTERS 115 (1994).

Tadatsugu Minami, *Transparent and Conductive Multicomponent Oxide Films Prepared by Magnetron Sputtering*, 17 J. VACUUM SCI. & TECH. A 1765 (1999).

Satoru Narushima et al., *Electronic Structure and Transport Properties in the Transparent Amorphous Oxide Semiconductor 2 CdO·GeO<sub>2</sub>*, 66 PHYSICAL REV. B 035203 (2002).

The following rejections are before us for review:

(1) The Examiner rejected claims 1, 2, 6-9, 18, 20, 37, 38, and 42-44 as being unpatentable under 35 U.S.C. § 103(a) over the combined teachings of Hamada, Phillips, and Narushima.

(2) The Examiner rejected claims 10-13 and 39 as being unpatentable under 35 U.S.C. § 103(a) over the combined teachings of Hamada, Phillips, Narushima, and Minami.

(3) The Examiner rejected claims 14-17, 40, and 41 as being unpatentable under 35 U.S.C. § 103(a) over the combined teachings of Hamada, Phillips, Narushima, Minami, and Raviendra.

(4) The Examiner rejected claims 48-52 as being unpatentable under 35 U.S.C. § 103(a) over the combined teachings of Akimoto, Hamada, Phillips, and Narushima.

(5) The Examiner rejected claims 53 and 54 as being unpatentable under 35 U.S.C. § 103(a) over the combined teachings of Akimoto, Hamada, Phillips, Narushima, and Minami.

(6) The Examiner rejected claims 55 and 56 as being unpatentable under 35 U.S.C. § 103(a) over the combined teachings of Akimoto, Hamada, Phillips, Narushima, Minami, and Raviendra.

## ISSUE

Did the Examiner err in determining that the combination of Hamada and Phillips teaches or suggests the limitation of

wherein the channel includes one or more compounds of the formula  $A_xB_xO_x$ , wherein the one or more compounds of the formula  $A_xB_xO_x$  includes one or more of gallium-germanium oxide, gallium-tin oxide, gallium-lead oxide, indium-

germanium oxide, indium-lead oxide, each O is atomic oxygen, where each x is a non-zero number . . .  
as recited in claim 1 and similarly recited in claims 18, 37, and 48?

## FINDINGS OF FACT

The following Findings of Fact are supported by a preponderance of the evidence:

1. Phillips teaches that “[i]ndium tin oxide (ITO) has become the TCO [(transparent conducting oxide)] of choice for a wide variety of applications from solar cells to flat panel displays for at least 20 years” (col. 1, ll. 3-6).
2. Phillips teaches that “GaInO<sub>3</sub> is a recently identified transparent conductive material” (col. 1, ll. 17-18).
3. Forrest teaches that “[c]ommonly used metal substitutes for electrodes and charge transfer layers would include wide bandgap semiconductors, for example, transparent conducting oxides such as indium tin oxide (ITO), tin oxide (TO), gallium indium tin oxide (GITO), zinc oxide (ZO) and zinc indium tin oxide (ZITO)” (col. 5, ll. 28-33).
4. Forrest teaches that the ITO is a semiconductor that has been “highly doped” to become a “conductive” “metal substitute” (col. 5, ll. 25-40).

## PRINCIPLE OF LAW

“[I]f a claim is amenable to two or more plausible claim constructions, the USPTO is justified in requiring the applicant to more precisely define the metes and bounds of the claimed invention by holding the claim unpatentable under 35 U.S.C. § 112, second paragraph, as indefinite.” *Ex parte Miyazaki*, 89 USPQ2d 1207, 1211 (BPAI 2008) (precedential)

(indicated as precedential at  
<http://www.uspto.gov/web/offices/dcom/bpai/prec/fd073300.pdf>).

A dependent claim in a patent that fails to “specify a further limitation of the subject matter’ of the [independent] claim to which [the dependent claim] refers” is invalid under 35 U.S.C. § 112, ¶ 4. *See Pfizer, Inc. v. Ranbaxy Labs., Ltd.*, 457 F.3d 1284, 1291-92 (Fed. Cir. 2006).

## ANALYSIS

*Does the combination of Hamada and Phillips, and as evidenced by Forrest, teach or suggest the limitation of*

*wherein the channel includes one or more compounds of the formula  $A_xB_xO_x$ , wherein the one or more compounds of the formula  $A_xB_xO_x$  includes one or more of gallium-germanium oxide, gallium-tin oxide, gallium-lead oxide, indium-germanium oxide, indium-lead oxide, each O is atomic oxygen, where each x is a non-zero number . . .*

*as recited in claim 1 and similarly recited in claims 18, 37, and 48?*

Appellants argue *inter alia* (App. Br. 12-14; Reply Br. 5-6) that the combination of Hamada and Phillips fails to teach or suggest the limitation of

*wherein the channel includes one or more compounds of the formula  $A_xB_xO_x$ , wherein the one or more compounds of the formula  $A_xB_xO_x$  includes one or more of gallium-germanium oxide, gallium-tin oxide, gallium-lead oxide, indium-germanium oxide, indium-lead oxide, each O is atomic oxygen, where each x is a non-zero number . . .*

*as recited in claim 1 and similarly recited in claims 18, 37, and 48.*

Appellants further argue (App. Br. 13-14; Reply Br. 8-9) that Phillips does not teach or suggest replacing the semi-conducting indium-tin oxide

(ITO) channel layer of Hamada with Phillips's highly-conductive “transparent conducting” materials.

The Examiner reasons (Ans. 26) that “one of ordinary skill in the art, combining Harada [sic] et al. and Phillips et al. would have known that transparent conducting oxides (including GaInSnO (GITO) and ITO) exhibit semiconductive properties, and thus would not have been deterred from making the combination.” The Examiner finds (Ans. 26) that Forrest “provides evidence that GITO and ITO are known in the art to be transparent conducting oxides exhibiting semiconductive properties (Forrest et al., col. 5, lines 25-40).”

Appellants respond (Reply Br. 9-11) that Forest describes GITO and ITO as conductive “metal substitutes,” not as compatible substitutes for Hamada’s semi-conductive channel layers.

We are persuaded by Appellants’ arguments because the secondary reference, Phillips, does not teach using the  $\text{GaInO}_3$  material as a semiconductor (semi-conducting) material that can specifically function as a channel (a semiconductor transistor layer formed of a composition that enables the layer’s conductivity to be changed between a conducting state and a non-conducting state based upon the voltage applied to the transistor’s gate). In contrast, Phillips teaches (FF 1, 2) using ITO and  $\text{GaInO}_3$  as conductive layers. Forrest does not provide evidentiary support for the above combination because Forrest only teaches (FF 3)  $\text{GaInO}_3$  as a *metal substitute* for electrode and charge transfer layers in the optoelectronic devices, which is different and not comparable to a semi-conductive channel layer as described in Hamada. In other words, the “charge transfer layer” as disclosed in Forrest does not constitute a functional equivalent of Hamada’s

“semi-conductor activate” (or channel) layer. We agree with Appellants (Reply Br. 10), that in Forrest the ITO is a semiconductor that has been “highly doped” to become a “conductive” “metal substitute” (FF 4). Thus, the suggested modification by the Examiner is improper.

For these reasons, we will reverse the Examiner’s rejection of claim 1 and of independent claims 18, 37, and 48 which have similar limitations. We will also reverse the Examiner’s rejections of claims 2, 6-17, 20, 38-44, and 49-56 which depend from independent claims 1, 18, 37, and 48.

## CONCLUSION

The Examiner erred in determining that the combination of Hamada and Phillips teaches or suggests the limitation of

wherein the channel includes one or more compounds of the formula  $A_xB_xO_x$ , wherein the one or more compounds of the formula  $A_xB_xO_x$  includes one or more of gallium-germanium oxide, gallium-tin oxide, gallium-lead oxide, indium-germanium oxide, indium-lead oxide, each O is atomic oxygen, where each x is a non-zero number . . .

as recited in claim 1 and similarly recited in claims 18, 37, and 48.

## NEW REJECTIONS UNDER 37 C.F.R. § 41.50(B)

*Rejection of claims 1, 2, 6-18, 20, 37-44, and 48-56 under 35 U.S.C. § 112, second paragraph*

Claims 1, 2, 6-18, 20, 37-44, and 48-56 are rejected under 35 U.S.C. § 112, second paragraph, as being vague and indefinite as failing to set forth claims particularly pointing out and distinctly claiming the subject matter which Appellants regards as their invention.

Independent claims 1, 18, 37, and 48 recite “compounds of the *formula A<sub>x</sub>B<sub>x</sub>O<sub>x</sub>*” (emphasis added) which can be interpreted as closed-ended as Appellants argue (App. Br. 12-14; Reply Br. 6-9) or as open-ended as the Examiner argues (Ans. 24-25).

More specifically, Appellants contend (App. Br. 12-14; Reply Br. 6-9) that the term “compounds of the *formula A<sub>x</sub>B<sub>x</sub>O<sub>x</sub>*” (emphasis added) is closed-ended and the compounds cannot contain additional elements. Therefore, Appellants assert Phillips’s GaIn<sub>1-x</sub>Sn<sub>x</sub>O<sub>3</sub> does not read on the limitation “compounds of the *formula A<sub>x</sub>B<sub>x</sub>O<sub>x</sub>* includes . . . gallium-tin oxide . . .” (emphasis added).

The Examiner responded (Ans. 24-25) that the claim 1 disputed limitation is “open-ended” because dependent claim 6 states “wherein the one or more compounds of the formula A<sub>x</sub>B<sub>x</sub>O<sub>x</sub> *includes* C<sub>x</sub> to form a compound of the formula A<sub>x</sub>B<sub>x</sub>C<sub>x</sub>O<sub>x</sub>” (emphasis added). Thus, the Examiner reasoned (Ans. 24-25) that for claim 1 to be broader than claim 6, the claim 1 limitation “one or more compounds of the formula A<sub>x</sub>B<sub>x</sub>O<sub>x</sub>” must *include* the claim 6 compound A<sub>x</sub>B<sub>x</sub>C<sub>x</sub>O<sub>x</sub> among other alternatives and therefore the claim 1 limitation is open-ended.

In other words, Appellants argue that formula A<sub>x</sub>B<sub>x</sub>O<sub>x</sub> is closed-ended (only A<sub>x</sub>B<sub>x</sub>O<sub>x</sub> which does not include A<sub>x</sub>B<sub>x</sub>C<sub>x</sub>...O<sub>x</sub>). However, Appellants’ dependent claim 6 recites “formula A<sub>x</sub>B<sub>x</sub>O<sub>x</sub> includes C<sub>x</sub>” which is confusing because the independent claim 1 formula that is closed-ended to the particular components, as argued by Appellants, would then also include the additional element C<sub>x</sub> as recited in claim 6.

Therefore, the claim 1 term of “compounds of the formula A<sub>x</sub>B<sub>x</sub>O<sub>x</sub>” is amenable to two or more plausible claim constructions (i.e., one being open-

ended as argued by Appellants and one being closed-ended as presented by the Examiner), thereby justifying requiring Appellants to more precisely define the metes and bounds of the claimed invention by holding the claim unpatentable under 35 U.S.C. § 112, second paragraph, as indefinite. *See Miyazaki*, 89 USPQ2d at 1211.

Accordingly, we herein institute a new ground of rejection for claims 1, 2, 6-18, 20, 37-44, and 48-56 under 35 U.S.C. § 112, second paragraph.

*Rejection of claims 6-17, 38-40, and 51-56 under 35 U.S.C. § 112, fourth paragraph*

Claims 6-17, 38-40, and 51-56 are rejected under 35 U.S.C. § 112, fourth paragraph, for not specifying a further limitation of the subject matter claimed. The dependent claims contain a limitation similar to “formula  $A_xB_xO_x$  includes  $C_x$ .” If the independent claim 1 limitation is closed-ended, as argued by Appellants (App. Br. 14; Reply Br. 6-9), then claim 1 would not include the claim 6 element  $C_x$  (*see* claim 6 limitation of “formula  $A_xB_xO_x$  includes  $C_x$ ”). Thus, claim 6 and other similar dependent claims 7-17 38-40, and 51-56 do not further limit the composition of claim 1, but instead, substitute an alternate composition  $A_xB_xC_xO_x$  for the composition  $A_xB_xO_x$  of claim 1. Such a substitution is prohibited by 35 U.S.C. § 112, fourth paragraph. *See Pfizer, Inc. v. Ranbaxy Labs., Ltd.*, 457 F.3d 1284, 1291-92 (Fed. Cir. 2006).

Accordingly, we herein institute a new ground of rejection for claims 6-17, 38-40, and 51-56.

ORDER

The decision of the Examiner to reject claims 1, 2, 6-18, 20, 37-44, and 48-56 is reversed.

We enter a new ground of rejection for claims 1, 2, 6-18, 20, 37-44, and 48-56 under 35 U.S.C. § 112, second paragraph.

We enter a new ground of rejection for claims 6-17, 38-40, and 51-56 under 35 U.S.C. § 112, fourth paragraph.

This decision contains new grounds of rejection pursuant to 37 C.F.R. § 41.50(b). Section 41.50(b) provides that “[a] new ground of rejection . . . shall not be considered final for judicial review.”

Section 41.50(b) also provides that Appellants, **WITHIN TWO MONTHS FROM THE DATE OF THE DECISION**, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of the appeal as to the rejected claims:

(1) *Reopen prosecution.* Submit an appropriate amendment of the claims so rejected or new evidence relating to the claims so rejected, or both, and have the matter reconsidered by the examiner, in which event the proceeding will be remanded to the examiner. . . .

(2) *Request rehearing.* Request that the proceeding be reheard under § 41.52 by the Board upon the same record.

37 C.F.R. § 41.50(b) (emphases added).

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1). *See* 37 C.F.R. § 1.136(a)(1)(iv) (2010).

REVERSED  
37 C.F.R. § 41.50(b)

Appeal 2009-008056  
Application 10/799,961

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